

Electrical Specifications
prepared by:

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SECTION 16050

ELECTRICAL; BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01. WORK INCLUDED

- A. All labor, material, equipment and services necessary to construct and install a complete electrical system as shown on the plans and as specified herein. All General Conditions and Requirements outlined elsewhere in these specifications or drawings shall be applied to this electrical section.
- B. Fire Alarm and annunciation system as required by the local Fire Marshal or authority having jurisdiction, including all monitoring equipment and wiring for central station connection.
- C. Lighting Systems, both interior and exterior as shown on the plans and as specified herein, including controls, lamps, supports, fasteners, straps, and miscellaneous mounting hardware for such equipment.
- D. Electrical Utility site work as required by the serving companies.
- E. HVAC Electrical: Conductors and terminations of all line voltage power, line voltage controls and safety disconnect switches for HVAC equipment including air conditioners, furnaces, fans, heat pumps, etc. including protective devices.
- F. Plumbing Electrical: Conductors and terminations of all plumbing equipment with power requirements including necessary safety disconnect devices.
- G. Power and Lighting Distribution: Furnish and install all power and lighting distribution systems including but not limited to panels, feeders, branch circuits, devices, fixtures, etc. for a complete working system.
- H. Voice/Data System: prewire to all outlets shown on drawings including telephone conductors to telephone backboard.

- I. Cable Television prewire with RG-59 coaxial cabling to outlets shown on plan.
- J. Written Method of Procedure (MOP) for building Owner's review and approval prior to performing work.

1.02. RELATED WORK (COORDINATE WITH CONTRACTOR PERFORMING WORK).

- A. Low Voltage Mechanical Wiring: Electrical Contractor shall provide connections to mechanical equipment where voltage exceeds 50 and provide necessary low voltage (under 50) controls raceways as required. All low voltage control circuit wiring for mechanical equipment shall be the Mechanical Contractor's responsibility.
- B. Painting of electrical equipment where exposed and required by the Contracting Officer to be painted as described elsewhere in the specification.
- C. Sprinkler System: Coordinate/verify requirements with supplier.

1.03. SYSTEM DESCRIPTION

- A. The electrical plans indicate the general layout and arrangement; exact locations shall be determined by the architectural drawings and field conditions. Field verify all conditions and modify as required to satisfy design intent. Maintain all required working clearances.
- B. Discrepancies shall be brought immediately to the attention of the Contracting Officer for clarification. Any changes shall be approved by the Contracting Officer. Prior to rough-in, refer to architectural plans which shall take precedence over electrical plans with respect to locations.
- C. Field verify all power and communications requirements prior to commencement of any utility work.

1.04. SUBMITTALS AND SHOP DRAWINGS

Before construction, submit 35 days after notice to proceed in accordance with the General Conditions of this Specification:

- A. A complete list of all materials proposed to be furnished and installed under this section.
- B. Manufacturers' specifications, catalog cuts and shop drawings including switchgear, light fixtures, fire alarm system, conduit and cabling, special equipment, terminal boards, panels, contactors, fuses, etc. as required to demonstrate compliance with the specifications. Identify specific intended use for each component where submittal may be ambiguous. Submit entire bound submittal at one time; partial submittals will not be accepted unless otherwise noted on submittal review.
- C. Manufacturers' recommended installation procedures which, when approved by the Contracting Officer, will become the basis for inspecting and accepting or rejecting actual installation procedures used on the work.
- D. The intent of these specifications is to establish a standard of quality for materials and equipment. Therefore, some items are identified by manufacturer or trade name designation. Substitutions shall be subject to the Contracting Officer's approval. Samples of the proposed and substitute materials may be required for inspection prior to approval. Costs, if any, for evaluation of substitutions shall be the Contractor's responsibility. The decision of the Contracting Officer shall be final. Where the substitution will affect other trades, coordinate all changes with those trades concerned and pay any additional costs incurred by them as a result of this substitution. Approval of substitutions shall not relieve the Contractor from providing an operational system in accordance with all applicable codes and ordinances.

1.05. DELIVERY, STORAGE, AND HANDLING

- A. Storage of equipment for the job is the responsibility of the Electrical Contractor and shall be scheduled for delivery to the site as the equipment is required. Damage to the equipment delivered to the site or in transport to the job shall be the responsibility of the Electrical Contractor.

PART 2 - PRODUCTS

2.01. MATERIALS

- A. Materials shall be new and bear the label of or be listed by a nationally recognized testing laboratory. The quality and suitability of all materials shall conform to the standards and practices of this trade.

PART 3 - EXECUTION

3.01. INSTALLATION

- A. Professionalism and appearance of all installations shall be in accordance with accepted practices of this trade. Installation methods shall conform to manufacturers' specifications. The Contractor shall man the job with qualified journeymen and helpers in this trade for the duration of the job. It is the Contractor's responsibility to communicate with and keep the job superintendent appraised of changes or clarifications, etc.
- B. Materials shall be installed in a professional fashion according to manufacturers' specification and recommendations and must conform to the 1993 CEC and all applicable codes and standards including but not necessarily limited to California Code of Regulations Title 24, NFPA, National Electrical Manufacturers Association and any other adopted ordinances of applicable agencies having jurisdiction.
- C. Layout: The Electrical Contractor shall lay his work out in advance in order to avoid unnecessary cutting, chasing, and drilling of floors, walls, ceilings and other surfaces. Work of this nature shall be carefully done so as not to damage work already performed by other trades. Any damage which results must be properly repaired at no extra cost to the Owner. Such alterations shall not depreciate the integrity of the structure. Approval for cuts or penetrations in structural members shall be approved by the Contracting Officer.
- D. Coordinate work with other trades as required to eliminate any delays during construction. Coordinate any and all changes with the Contracting Contractor to avoid conflicts.
- E. Engineer's Field Observation: When Electrical Engineering representative performs a field observation, the Electrical Contractor shall be present and available to remove equipment covers as needed.

- F. Drawings of Record: Provide a full and accurate set of field record drawings marked up in a neat and understandable manner submitted to the Contracting Officer upon completion of the work and prior to issuance of a certificate of completion. The drawings shall dimension all underground conduit routing scaled to within 12" of actual field conditions and shall be kept up to date on a daily basis reflecting any and all changes or deviations. All underground facilities shall be accurately drawn on the plan to scale. Refer to the general conditions of these specifications for additional requirements.
- G. Identification: Provide engraved laminated plastic nameplates for all switchboards, panelboards, fire alarm terminal cabinets, telephone and cable television backboards, main devices, control panels, time clocks, contactors and safety disconnect switches accurately identifying each device. Labels shall be attached to the equipment by means of screws or rivets. Self-adhering labels will not be acceptable.
- H. Safety: The Electrical Contractor is responsible to maintain all equipment in a safe and responsible manner. Keep dead front equipment in place while equipment is energized. Conduct all construction operations in a safe manner for employees as well as other workpersons or anyone visiting the job site. Provide barriers, flags, tape etc. The Contractor shall hold all parties harmless of negligent safety practices which may cause injury to others on or near the job site.
- I. Guarantees: All equipment and labor shall be guaranteed and warranted free of defects, unless otherwise stated to be more restrictive, for a period of one year from the date of final acceptance by the Owner. A written warranty shall be presented to the Contracting Officer at the time of completion prior to final acceptance. Equipment deemed to be damaged, broken or failed shall be repaired or replaced at no additional cost to the Owner.
- J. Operating and Installation Manuals: Provide two copies each of all manuals, operating and installation instructions for equipment indicated in submittal packages. Instruct the Owner's representative as to the operation and location of all equipment necessary to allow them to operate the facility upon final acceptance. This instruction period shall be prearranged with the Contracting Officer's representative prior to occupancy of the facility.

END OF SECTION

SECTION 16110

RACEWAYS

PART 1 - GENERAL

1.01. WORK INCLUDED

- A. Provide raceways for all conductors serving0 new and existing devices.
- B. All line voltage wiring conduits within the building.

PART 2 - PRODUCTS

2.01. MATERIALS

- A. Minimum conduit size shall be 1/2" except if plan shows or code requires larger size. Exception: Use minimum 3/4" for underslab homeruns and below grade outside of building exterior walls.
- B. Heavy-wall rigid non-metallic conduit, where permitted, shall be PVC schedule 40 manufactured in accordance with NEMA Standard TC-2, UL-651 and WC 1094A specifications. Approved manufacturers are Carlon, Certainteed, R&G Sloane or equal.
- C. Extra heavy wall non-metallic conduit, where required shall be PVC schedule 80 manufactured in accordance with NEMA Standard TC-2, UL-651 and WC 1094A specifications. Approved manufacturers are Carlon, Certainteed, R&G Sloane or equal.
- D. Rigid utility duct, where permitted by the serving utilities, shall be PVC power and communications duct, type EB for concrete-encased burial and type DB for direct burial. Only products in compliance with NEMA Standards TC-6, TC-8 or TC-10 as applicable and ASTM Standard F512 will be permitted. Approved manufacturers are Carlon, Certainteed, R&G Sloane or equal.
- E. Galvanized rigid steel conduit shall be hot dipped galvanized, zinc coated and shall comply with Underwriters Laboratories UL-6, ANSI Specification C-80.1 and Federal Specification WW-C-581E.
- F. Electrical metallic tubing shall be zinc coated, with a protective coating applied to the inside surface and shall comply with Underwriter Laboratories UL-797 ANSI Specification C-80.3 and Federal Specification WW-C-563A.
- G. Flexible metal conduit shall be continuous wound reduced wall galvanized steel produced to UL standards as manufactured by Alfex, American Flexible Conduit or equal.

- H. Liquid tight flexible metal conduit shall have a thermoplastic cover over a galvanized steel core containing an integral copper ground in sizes to 1-1/4" and shall be in compliance with UL standards and CEC Article 351a. Approved manufacturers are Anaconda (type UA), Electri-flex Liquidtight or equal.
- I. Surface mount raceway shall be used where shown on the plans. The raceway and cover shall be capable of being over-painted in the field if required. The raceway and fittings shall meet all requirements of CEC Article 352 and be UL listed. Approved manufacturer is Wiremold or equal.
- J. Electrical Nonmetallic Tubing (ENT) shall be corrugated PVC complying with NEMA TC-13, UL-listed and ICBO-recognized for use in 2-hour fire-rated construction. Approved manufacturers are Carlon, Certainteed and PW Pipe.

PART 3 - EXECUTION

3.01. INSTALLATION

- A. Empty or Future conduits shall be correctly plugged with plastic caps or inserts with a 3/8" polyethylene pull rope. Plastic or "duct" tape will not be acceptable.
- B. Exterior installations: After conductors are installed, tape conduit ends to prevent entrance of foreign material.
- C. Trenching and backfilling for all conduit systems installed by the Electrical Contractor shall be the responsibility of the Contractor. All conduits shall have minimum cover requirements as specified in CEC 300-5. Joint trenching should be utilized where practicable. Sand shall be used as backfill material and shall be compacted in accordance with and coordinated with the grading and site preparation requirements. Locations of existing UG systems shall be determined by calling the contracting Officer at least 48 hours prior to any excavation.
- D. Exposed conduit shall be run square and plumb with building lines in an approved manner. Support roofmount conduits with redwood blocks set in mastic. Strap conduits to blocks.
- E. All conduit systems listed below are for installations where they are allowed to be used by CEC or other occupancy restrictions. The below installation methods do not allow these methods to be used in conflict with any applicable code. Special attention to applications shall be made in building types such as Educational, Health Care, hazardous locations, assembly occupancy and multi-story, but not limited to these. The Electrical Contractor shall be responsible to use the proper conduit system for the application.

- F. Electrical metallic tubing (EMT) may be used where allowed. It shall not be in contact with soil or the concrete slab on the ground floor of any structure. Connectors and couplings may be set screw type where installed in indoor dry locations not subject to moisture. Where the potential for moisture is present, compression type weathertight fittings are required. One hole conduit straps are permitted from 1/2" to 1" and two hole conduit straps are required for sizes 1-1/4" and larger. Diecast fittings shall be acceptable. EMT shall not be allowed in areas subject to severe physical damage. Install copper ground wire sized per CEC 250-95 in all EMT conduit.
- G. Flexible conduit may be used where allowed. Maximum allowable length is 20' in any one linear path of an entire branch circuit and less where otherwise restricted, with a total directional change of 270 bending degrees. "Jake" type screw-in and squeeze type flex fittings rated as grounding connectors are permitted. Flexible conduit must be supported in accordance with CEC. Where exposed to the weather or moisture, flexible conduit shall be of the liquidtight type. Fittings shall be manufactured for use with liquidtight flexible conduit. All motor connections shall be made with liquidtight flex. Flexible conduit may not be used where exposed unless otherwise noted or approved. A copper ground wire sized per CEC 250-95 shall be installed in all flexible conduit runs.
- H. Non-metallic conduit may be used where allowed, in concrete slabs, below concrete slabs on grade, or underground outside of the building. Maintain minimum depth requirements and cover with appropriate fill material. Plastic conduit shall be heavy wall, rigid PVC only except where PVC power and communication duct is allowed by utilities, governing codes, and regulations. Proper grounding conductors shall be installed in all non-metallic conduit branch circuit and feeder runs. All elbows through slab shall be galvanized rigid steel PVC coated or tape wrapped. PVC conduit shall be formed or field bent only with the use of properly approved bending tools such as to not decrease the internal bore of the conduit. All conduit shall be cut square and reamed of burrs. An approved and compatible glue shall be used on all PVC fittings to attain water tight joints.

- I. Galvanized rigid steel (GRS) conduit may be used where allowed. Conduits shall be cut square and reamed to remove burrs and sharp edges. Unless otherwise noted, threadless set screw and threadless weather tight fittings may be used in lieu of threaded fittings. All threaded ends entering a junction box of any type shall require one locknut on the inside and one on the outside of the enclosure and be provided with a plastic bushing. Where exposed to moisture, a watertight hub or other approved method shall be required. Where below grade, GRS conduit shall be PVC coated or tape-wrapped. All elbows and riser conduits from below slab shall be rigid galvanized and PVC coated or tape wrapped from below grade to 3" above slab height or finish grade. All conduits shall be stubbed up straight and uniform into junction boxes, panels, cabinets etc.
- J. Electrical Non Metallic Tubing (ENT) may be used where allowed by local authorities and only in accordance with CEC 331. Use only fittings and glue listed for use with ENT. Install with grounding conductor where applicable. Color-code ENT as follows:
 - 1. Blue for power and lighting branch circuits.
 - 2. Red for fire alarm only.
 - 3. Yellow for communications and similar systems.
- K. Conduit Supports: Conduit runs may be supported by one-hole and two-hole straps or supports as manufactured by Unistrut, Minerallac, Caddy or equals. Supports may be fastened by means of anchors, shields, beam clamps, toggle bolts, or other accepted methods.
- L. Bends and offsets shall be made with approved tools for the type of conduit being utilized. Bends shall be made without kinking or destroying the smooth bore of the conduit. Parallel conduits shall be run straight and true with bends uniform and symmetrical. Minimum radii shall be per CEC 346-10.
- M. Conduit Stub-outs below grade shall be capped and identified by a 1-1/2" sq. x 18" long ground driven redwood stake with stamped identification on brass tag (e.g. "ELEC", "TEL", etc.). Dimension for exact location on field record drawings.
- N. Conduit Seals: Where below grade conduits enter structure through slab or wall of basement, seal the inside of each conduit as follows:
 - 1. Provide damming material around conductors 3" into conduit.
 - 2. Fill 3" of conduit with 3M #2114 sealing compound.
 - 3. Wrap conductors where they exit the conduit with 3M #2229 "Scotch Seal" mastic tape. Lap tape to approximate diameter of the raceway and wrap outside of conduit opening with (minimum) one turn.

REPAIR / ADD TO DINING HALL
BUILDING 13330
VANDENBERG AIR FORCE BASE

XUMU #96-1215 B/C

- O. Marker tape: Place plastic marker tape at 12" below finish grade along and above buried conduits. Label tape "CAUTION: ELECTRICAL LINES BELOW" or similar wording.

END OF SECTION

SECTION 16120

WIRES AND CABLES

PART 1 - GENERAL

1.01. WORK INCLUDED

- A. Provide all wiring and cables for complete working systems as shown on plans for power, lighting, control, signal and communications for proper system operation.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All conductors shall be copper unless otherwise noted. Minimum size for individual conductors shall be #12 AWG unless otherwise noted. Sizes #8 AWG and larger shall be stranded conductor. Control, signal and communications conductors may be smaller as dictated by CEC or specified on plan.
- B. Individual conductors shall be insulated with type, THHN/THWN 600 volt insulation unless otherwise noted.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Conductors shall not be installed until after conduit systems are permanently in place. Use an approved wire pulling lubricant if lubricant is to be used. Maintain all conduits and wire pulls free from foreign material. If due to field conditions, more than the code allowed number of bends are required, a pull box may be furnished and installed for ease of installation. Said pull boxes must be sized and rated for the appropriate application and must remain easily accessible upon completion of the project (approval of the location shall be obtained from the Contracting Officer prior to installation). Show these pullboxes on the field record drawings. Conductors installed in underground raceways on site shall be taped where they exit the raceway to prevent the entrance of foreign material after the conductors are installed.
- B. Insulation: Use proper insulation types where temperature and environment are a factor.
- C. Color code all wires in a consistent manner as set forth in the CEC or as indicated on the plans. Phasing tape will be permitted on sizes #6 and larger.

208Y/120 or 120/240 VOLT SYSTEM

1. Phase A: Black 4. Neutral: White

- | | |
|------------------|--------------------------|
| 2. Phase B: Red | 5. Traveler: Brown |
| 3. Phase C: Blue | 6. Ground: Green or Bare |

Exception:

120/240 3 phase 4 wire Delta systems shall have "stinger" leg ("C" phase conductor with 208 volt to ground) color coded orange and labeled "stinger" wherever appearing.

- D. Wire Connectors shall be minimum 75 degree rated and properly sized for the number of conductors being connected, terminated, spliced etc. All connectors shall be solderless lug or plastic wire nut type.
- E. Splices at or below grade level shall be made with approved connectors and shall be encapsulated in epoxy or plastic molded poured kits. The connections must be insured to be water tight. Splices at or below grade shall always be avoided and minimized.
- F. Labeling: All conductors in panels, switchboards, terminal cabinets and junction boxes shall be labeled with tape number markers indicating circuit number.
- G. MC Cable (metal clad) as manufactured by AFC or equal shall be permitted for interior dry location branch circuits only and shall be 90 degree rated, steel or aluminum armor, per UL Standard 1569, installed per CEC Article 334, with 600V THHN insulation including green insulated ground wire; Sizes #12 to #1, 2, 3 or 4 circuit conductors plus green ground. Note: Use only approved connectors for all MC cable terminations.

END OF SECTION

SECTION 16130

BOXES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide steel outlet boxes as shown on plans as required for proper system operations.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Steel outlet boxes shall be manufactured, sized and installed in accordance with CEC Article 370.
- B. Steel outlet boxes and plaster rings shall be galvanized rigid assemblies, either one piece pressed or factory welded construction containing the size and number of knockouts required.
- C. NEMA 1 gutter, junction and pull boxes shall be fabricated from code gage steel finished in grey enamel with screw cover fronts and concentric knockouts in all sides.
- D. NEMA 3R gutter, junction and pull boxes shall be fabricated from code gage galvanized steel with screw cover fronts and concentric knockouts in the bottom only. Any penetrations to the side, top or back shall be weatherproofed in an approved manner such as "MYERS" gasketed type hub or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Boxes shall be properly secured to the structure such that they are flush with the finish surface. Boxes shall be made structurally secure by means of the proper fastening devices.
- B. Locations: Junction boxes shall be located only where necessary and only in equipment rooms, closets, and accessible attic and underfloor spaces. Outlet boxes on opposite sides of occupancy separation walls, fire-rated walls or partitions shall be separated by a horizontal distance of 24 inches.
- C. Manufacturers: Gutter, junction and pull boxes shall be as manufactured by Circle AW, Wireguard, or equal.
- D. Labeling: Junction box covers shall be marked with indelible ink indicating the circuit numbers passing through the box.

- E. Exterior in-grade boxes for non-utility company use shall be:
1. Precast concrete or polymer concrete type stamped with "ELECTRIC", "LIGHTING", "COMMUNICATIONS", etc. cover identification as shown on the drawings or as applicable.
 2. Flushmount in hardscape and 1" above grade in softscape.
 3. Provided with correct traffic type lid, i.e., full vehicular, intermediate vehicular or pedestrian-rated as applicable.
 4. Provided with brass hold-down bolts in cover.
 5. Provided with necessary box extensions to gain proper depth.
- F. Floor mounted boxes shall be water tight and cast iron when installed in grade level concrete slab floor, fully adjustable with interior and exterior leveling screws. Receptacle flange shall be brass with a duplex lift lid. Flange type shall be compatible with floor type. Before installation, coordinate exact location with Contracting Officer.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide all wiring devices as shown on plans for a complete working system, devices shall be of the type specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Switches shall be 20 amp, 120/277 VAC rated, quiet, side wired, single-pole or 3-way as indicated on the drawings. Acceptable manufacturers are Leviton, Hubbell or equal.
- B. Convenience duplex receptacles shall be side wired, 20 amp NEMA 5-20R configuration. Acceptable manufacturers are Leviton, Hubbell or equal.
- C. Ground-fault circuit-interrupter type receptacles where shown on the drawings shall be duplex, NEMA 5-20R, 20amp, 125V AC Leviton 6899 or equal.
- D. Device plates shall be plastic, Sierra "P" line, Slater "Sta-Kleen" or equal for use against drywall. Surfacemount boxes shall use industrial raised galvanized steel covers.
- E. Isolated ground receptacles shall be 20 amp rated Hubbell IG5362GY or equal unless otherwise noted. Receptacles designated by I.G. are isolated ground type.

PART 3 - EXECUTION

1.01 INSTALLATION

- A. All devices shall be installed with "pigtailed" leads from the outlet box. No device shall be used in the "feed through" application. Screw terminals shall be used to connect all devices to the circuit and shall be grounded by means of a ground wire where grounding terminals are provided in the device.
- B. Devices and plates shall be installed in a "plumb" condition and must be flush with the finish surface of the wall where boxes are recessed.

- C. Colors: Devices and plates shall be white unless otherwise noted. Exception: When connected to emergency power system, devices and plates shall be red. Isolated ground receptacles (device only) shall be gray.
- D. Mounting heights: All control and convenience devices shall comply with California Code of Regulations Title 24 and ADA with respect to Handicap requirements. Switches shall be mounted between 36 and 48 inches above finish floor and receptacles shall be mounted not lower than 16 inches above finish floor; mounting heights indicated on plans shall have precedence.

END OF SECTION

SECTION 16160

PANELBOARDS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Main switchboard, panelboards, as shown on plans, shall be provided and installed in accordance with the plans and these specifications.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Main Switchboard: Provide serving electric utility approved service entrance equipment as indicated complete with circuit breakers and/or fuses as shown, applicable NEMA rated enclosures, voltage, phase, wiring and full capacity tin plated aluminum bussing with a minimum coordinated short circuit interrupting rating as shown on the plans. All equipment must be dimensioned in order to physically fit in the spaces provided and to comply with all code required clearances. Unused space shall be provided with bussing for future use.
- B. Branch circuit panels shall be of the panelboard (with bolt-in breakers) or load center (with plug-in breakers) type as indicated by the panel schedules. Panels shall have a dead front cover with hinged flush latching and locking door unless otherwise noted in the panel schedule. Each panel shall be complete with main lugs, main breaker or main fusible switch as shown, insulated neutral bus, and separate equipment grounding bus bonded to enclosure. Provide isolated ground bars where specified in addition to required grounded bus. Panels shall accommodate the number of full size circuit breakers specified by the panel schedule heading. A legibly typed and properly identified panel directory shall be included on the inside face of each panel door.
- C. Approved panel manufacturers are General Electric, Westinghouse, Square D, Murray Cutler-Hammer or Engineer-approved equal where meeting all specified requirements.
- D. Approved manufacturers are General Electric, Westinghouse, Square D, or engineer-approved equal provided all criteria can be met.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Main devices integral with branch circuit panels shall be vertically mounted; backfed main devices are unacceptable.
- B. All factory wiring shall be checked for correct tightness of bussing and terminations which might have become loose in transit.
- C. Terminals shall be minimum 75 degree rated.
- D. Label all Panels with 1/2" high phenolic black plates engraved with white letters 1/4" high. Fasten to panel with rivets.
- E. Recessed Panel Spare Conduit: Provide (1) 3/4" spare conduit stub up to accessible above ceiling space and/or interstitial space below as applicable for every (5) spares or spaces indicated on schedule.

END OF SECTION

SECTION 16170

MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide and install all motor and circuit disconnect devices as indicated on the plans as or required by the equipment.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. "Half size" or "twin" type circuit breakers shall not be acceptable.
- B. All 2pole and 3pole circuit breakers shall have factory furnished integral handle tie bars or internal common disconnection of all poles simultaneously.
- C. Circuit breakers shall be thermal-magnetic, common trip, quick break, trip free, and rated in accordance with UL standards. Where used for switching duty, use only breakers UL listed as SWD. Where used for heating, air conditioning and refrigeration equipment, use only breakers UL listed as HACR.
- D. Fuses: All fuses shall be as indicated on the plan or as required by the equipment. Verify fuse size with equipment manufacturer requirements, prior to installation. Use current limiting fuses as indicated on plan. Provide one spare fuse cabinet in each electrical room with one complete set of spare fuses for all sizes of main fuses, subpanel fuses, HVAC equipment fuses and fire alarm.
- E. Safety Disconnect Switches: Provide properly sized and rated disconnect switches as required by the equipment requiring disconnect switches. Provide properly rated NEMA enclosure. If fuses are required, provide the correct size as directed by the equipment manufacturer. Disconnect shall be General Duty unless otherwise noted.

PART - 3 EXECUTION

1.01 INSTALLATION

- A. Terminals shall be minimum 75 degree rated.

END OF SECTION

SECTION 16402

ELECTRIC SERVICE

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide trenching, conduit, backfill, boxes and transformer pad to provide new electric service as indicated on plans.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Approved Conduit: Size 1-1/2", 2", 3", 4", 5" & 6" conduits complying with ASTM Standard F512 for Utilities Duct shall be used. Approved type is P&C DB-120 as manufactured by Carlon. Other approved suppliers include Western Plastics, Apache, Certainteed, Gamma Products, Colby and Ingomar. Use PVC 40 for all service conduits within or under buildings and PVC 80 for any exposed conduit subject to damage.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Minimum Depth: Primary conduits minimum 30" ground cover. Secondary conduits minimum 24" ground cover.
- B. Pull Line: Install 3/16 inch polypropylene pull line, 800 pounds test strength in all conduits.
- C. All conduits should be proved free of obstructions, dirt, rocks, etc., by means of a mandrel not less than one-half inch smaller than the inside diameter of the conduit and minimum 12" long.
- D. Trench Preparation: A 4-inch sand bedding is required if trench bottom is not rock free. A 4-inch sand covering over the cable is required if the native backfill is not rock free.
- E. Excavation: Provide 6" gravel in bottom of excavated holes for subsurface transformers and all concrete boxes. Spare gravel shall be available for final adjustment. The Contractor is responsible for final grade level of enclosures and boxes. Non-conformance will be corrected by electrical contractor at his expense.
- F. Conduit Routing: Sharp turns, bends, or other irregularities in the conduit must be avoided. Every effort should be made to obtain a straight water tight conduit line. The end of all spare conduits must be capped.

- G. Joint Trenching: Maintain all required depths, clearance and separations as required by code.
- H. Locations of existing underground facilities shall be obtained by calling the Contracting Officer at least 48 hours in advance.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All installations shall be grounded and bonded in strict compliance with Article 250 of the NEC and California Electrical Code of Regulations (CEC).

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Ground Clamps shall be approved for the use and listed for the type, size wire, and environmental condition. Use solid brass clamps.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Grounding electrode system shall be as described in NEC and CEC Article 250H.
- B. Telephone and CATV: Provide copper ground wires from the main electrical service ground to the main telephone and cable television service termination location where shown on the plans.
- C. Bonding: All electrical systems shall be properly bonded throughout. Bond all metallic piping systems which may likely become energized as described in CEC Article 250-80 (a) and (b). Size bonding conductor per CEC table 250-95.
- D. Grounding bushings shall be used on conduits larger than 1" size, terminating in concentric knockouts of panels, junction boxes or equipment.
- E. Physically protect grounding conductors from damage by installing in conduit or raceway. All nonmetallic and flexible conduit shall contain a properly sized grounding conductor.
- F. Upsize grounding conductor proportionately to phase conductor(s) upsizing where required to compensate for voltage drop in accordance with CEC 250-95.
- G. Provide ground conductor in all conduit.

- H. Isolated Ground (IG) receptacles and branch circuits shall be installed with a separate isolated insulated ground wire (which may be spliced to other designated IG wires) in addition to the code-required equipment grounding conductor. This IG conductor shall be run the entire length of the branch circuit and back to the panelboard as applicable. Also install separate, dedicated neutrals, one for each IG branch circuit.

END OF SECTION

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install all lighting fixtures and lamps complete as specified on plans. Fixtures damaged in shipping shall be repaired or replaced at contractor's expense.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. All luminaires shall have been certified to the California Energy Commission by its manufacturer to comply with the efficiency standards as per California Code of Regulations Title 24, Part 6, Section 111 referencing the Appliance Efficiency Regulations in Title 20.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Fixtures shall be securely mounted on ceilings and walls with appropriate fastening devices. "Drop-in" type T-bar fixtures shall be secured with #12 gauge safety "earthquake wires" as described by California Code of Regulations Title 24 Part 2, Chapter 47. "Earthquake clips" will be required for fastening to the T-bar system in addition to safety wire. Surface mounted fluorescent fixtures shall be solidly screwed into wood framing above drywall with 4-#10 sheet metal screws into each fixture. Provide blocking for screw supports behind all surface mounted lighting fixtures weighing more than 15 lbs.
- B. Recessed fixtures shall be of the type approved for the ceiling and insulation conditions and appropriate for the installation location. Insulation must be held back from the fixture to provide manufacturers' recommended clearances for proper operation. Thermal tripping shall be the installer's responsibility to correct. Where installed in fire rated ceilings, coordinate installation of fire rated enclosures around the ceiling penetrations. Fixtures shall contain the proper through wiring capacity for that which is shown on the plans.
- C. Recessed fluorescent fixtures shall be provided with the appropriate trims and hardware compatible with the ceiling type shown. Plaster frames are required where plaster or gypsum board ceilings are encountered.

- D. Tandem-wire center lamps on 3-lamp fixtures. Verify and provide factory "whip" lengths as required.
- E. Provide unswitched leg of interior lighting branch circuit to integral emergency battery pack light fixtures, exit signs and night lights as applicable per lighting plans.
- F. Wallmount fixtures in walkway areas shall not project more than 4 inches from wall when projection occurs lower than 80 inches.
- G. Locations: Fixtures shall be installed per electrical drawings but shall be scaled for exact location from architectural and reflected ceiling plans.
- H. Pendant fixtures shall be securely fastened to structural members per manufacturer's recommendations.

END OF SECTION

SECTION 16501

LAMPS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide lamps as specified in the light fixture schedule.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Incandescent lamps shall be 130 volt as manufactured by GE, Philips, Sylvania or equal.
- B. Fluorescent lamps shall be as indicated on the fixture schedule and as manufactured by GE, Philips or Osram/Sylvania unless otherwise noted. All fluorescent lamps shall be SP35WM deluxe unless otherwise noted.
- C. HID lamps shall be as indicated on the fixture schedule. Mercury lamps shall be deluxe white color. High Pressure Sodium (HPS) and Metal Halide lamps shall be clear or coated as specified. Approved manufacturers are GE, Osram/Sylvania, Philips, Venture or equal. Where lamps are oriented horizontally, they shall be manufactured as suitable for the application.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Insall lamps in lightitng fixtures as per lighting fixture schedule.

END OF SECTION

SECTION 16502

BALLASTS AND ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install all ballasts and accessories integral with lighting fixtures as specified on plans.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Rapid start ballasts shall be sound rating A high-power factor 430 mA.
- B. Slimline ballasts shall be sound rating C high-power factor 425 mA.
- C. Shielding: All lens material shall be 100% virgin acrylic, .095" minimum thickness, unless otherwise indicated in the fixture schedule. Diffusers shall comply with UBC 5209.
- D. Fluorescent ballasts shall be UL listed Class P thermally protected and recognized by the Certified Ballast Manufacturers (CBM). Approved manufacturers are Advance, Universal and GTE Sylvania.
- E. Energy saving: All fluorescent ballasts shall be energy saving type where available, Advance Mark III, Universal SLH, Magnetek or equal.
- F. All ballasts shall have been certified to the California Energy Commission by its manufacturer to comply with the efficiency standards as per California Code of Regulations Title 24, Part 6, Section 111 referencing the Appliance Efficiency Regulations in Title 20. Post certification with building permit.
- G. HID ballasts shall be manufactured by Advance, Universal or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- H. Performance: Ballasts shall carry a minimum 2 year warranty. Any ballast deemed noisy by the Contracting Officer shall be replaced at no charge to the owner.
- I. Electronic Ballasts (same as solid state) shall be manufactured by Motorola, Magnetek, EBT or Advance with:
 - 1. Maximum 20% total harmonic distortion.
 - 2. Minimum 0.9 power factor.
 - 3. Minimum 0.85 ballast factor.
- J. Maintain accessibility of all ballast locations.

END OF SECTION

SECTION 16721

FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide a complete, power limited, fire detection and evacuation system to be connected, tested and left in first-class operating condition.

PART 2 - PROCUDTS

2.01 MATERIAL

- A. All equipment herein specified shall be manufactured by Simplex or engineer-approved equal and California State Fire Marshal (CSFM) listed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The entire installation shall conform to the National Fire Protection Association (NFPA) Standard 71, 72, 72E, 90A & CEC Article 760 and authorities having jurisdiction as applicable.
- B. Supervision: The fire alarm system shall monitor the integrity of all alarm initiating and indicating appliance circuits, and shall be provided with automatically charged standby batteries to maintain system operation for 24 HRS in the normal supervisory mode plus for 5 minutes of alarm at the conclusion of this supervisory time period. Batteries shall be supervised for connection to the system and low voltage threshold. The automatic battery charger shall be capable of charging fully discharged system batteries to 100% in 8 hours for systems with 24 hours of standby.
- C. The system wiring and installation shall be as required by the manufacturer. All wiring shall be color coded, tagged and checked to assure that it is free from shorts and grounds.
- D. Testing: The completed system shall be tested in accordance with NFPA Standard 72H.
- E. Warranty: The equipment and wiring shall be warranted to be free from electrical and mechanical defects for a period of one (1) year commencing with filings of notice of completion.
- F. System Operation shall include:
 - 1. Separate zone indication by LED.

2. Audibles to sound in General Alarm Pattern and Visuals to flash throughout the facility until acknowledge/silence switch is operated.
 3. Supervision of all circuits to indicate any abnormal wiring condition.
 4. 24VDC output power and relays as required for external device use.
 5. Central station connection capable of indicating (3) distinct separate signals being tamper, trouble and alarm.
- G. Fire Alarm Control Panel (FACP) is existing. Provide all work and material required to connect new devices.
- H. External devices shall be as noted on the drawings.

END OF SECTION

SECTION 16930

LIGHTING CONTROL EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide all lighting control equipment to provide proper control as shown on plans.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. All ultra-sonic sensors shall comply with California building code, Section 2-5319(f) and 2-5319 exception 3B.
- B. Occupancy sensors shall be 24V DC with adjustable sensitivity and time delay and be capable of detecting motion by Doppler shifts in transmitted ultrasound. Ultrasonic frequency shall be 25khz +/- 0.005, and shall not interfere with other occupancy sensors in the same room. Sensor shall contain a shunt provision to by-pass the sensor in the event of failure. Watt stopper # W- 2000A or engineer approved equal.
- C. Power pack shall be 24V DC with 100mA output and a 120VAC to 24V DC transformer and contact closure relay in one package. Housing shall be ABS, UL-rated 94V-0 plastic enclosure, capable of mounting to a standard junction box. Wattstopper #A120-E or engineer approved equal.
- D. Slave pack shall be 24V DC and contain a contact closure relay. Housing shall be ABS, UL-rated 94V-0 plastic enclosure. Wattstopper #S-120/277-D or Engineer approved equal.
- E. Dual technology sensor shall detect motion with both ultrasound and infrared sensing technologies. Sensor shall have both adjustable sensitivity and time delay and shall operate via an integral 24V DC power supply. Wattstopper DT-100 or engineer approved equal.

PART 3 - EXECUTION

1.01 INSTALLATION

- A. All devices for automatic lighting controls shall be of the same manufacturer.
- B. Complete control schematics shall be included with automatic lighting control system submittals.
- C. Low voltage wiring between power packs and sensors and slave packs shall be 18ga. Plenum rated, class 2 cable.

- D. Lumen sensor shall be capable of switching lights in sun lit areas. It shall include an adjustable preset time delay and dead band to prevent cycling and dual color LED displays for indication of current triggering status. Wattstopper LS-100XA or Engineer approved equal.
- E. Time Switch Override: Provide Paragon #ET-PD/120 (or approved equal) set for a 2-hour maximum per CEC Section 131(d)2 for override of building interior lighting time switch control. Locate time switch(es) as shown on plans.
- F. Building Automatic Shut-Off: Provide all work and material as shown and/or required for building lighting control to comply with California energy Code (CEC). The Contractor shall have the following options to control those circuits indicated on the panel schedules:
 - 1. Programmable Time Switch (Paragon #EC-74/192MA or approved equal) California Energy Code (CEC) certified 4-channel electronic time control device per CEC Section 119(c), output channel/circuits "C1" and "C2" shall include AstroDial Feature. Program output channel/circuits as follows:
 - C1: on at sunset; off at sunrise (night lights)
 - C2: on at sunset; off at Owner-specified time (evening lights)
 - C3: on and off at Owner-specified times (interior lights)
 - C4: on and off at Owner-specified times (spare)

Time switch to be used in conjunction with lighting contactors. (Square D Class 8903 or approved equal)
Components to be mounted in a lighting controls equipment cabinet with wood backboard. (Square D Class 6650 or equal).
 - 2. Low voltage lighting control panel (Lithonia #RCSK series or approved equal).

END OF SECTION